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(54) Title: DETERMINATION OF THE PROPAGATION DELAY IN A PACKET SWITCHED NETWORK.

(57) Abstract

A method of determining the propagation delay over a packet switched network intented to provide a segment of a telephone circuit. In response to a request for a telephone circuit between two subscribers, a packet containing an echo request message is transmitted over the packet switched network from a first network node to a second network node. The second network node reacts to receipt of the echo request message by transmitting a packet containing an echo reply message to the first network node. The first network node then determines the round trip propagation delay for the packet switched network segment on the basis of the time which elapses between sending the echo request message from the first node and receiving the echo reply message also at the first node.

DETERMINATION OF THE PROPAGATION DELAY IN A PACKET SWITCHED NETWORK

Field of the Invention

5   The present invention relates to packet switched
     networks and more particularly to the transmission of
     real time voice and data information over a packet
     switched network.

10   Background to the Invention

     Conventional telecommunications networks for conveying
     voice and other user information have in general relied
     upon dedicated telecommunications network infrastructure
15   and transmission protocols. However, with the recent
     explosive growth in digital data transmission, driven in
     particular by the use of intranets and the Internet,
     there has been a move towards the use of more generic
     infrastructure and transmission protocols in the
20   telecommunications industry. This move is driven
     primarily by the desire for interoperability between
     telecommunications networks and other data networks, and
     secondarily by the cost and performance advantages which
     general data network systems offer over conventional
25   telecommunications systems.

     There exist proposals for the replacement of certain
     parts of telecommunications networks with packet
     switched networks and in particular with Internet
30   Protocol (IP) networks. For example, telephone
     exchanges may be interconnected via IP networks for the
     purpose of carrying both signalling and user voice and
     data information.

35   Subscriber telephone terminals in a Public Switched
     Telephone Network (PSTN) are generally connected to

respective local exchanges via two-wire connections which provide for duplex (i.e. bidirectional) communication. A so-called "hybrid" located at the local exchange converts the bidirectional voice signals

5 from the two-wire lines into unidirectional signals for transmission over four-wire lines used in the inter- exchange trunk connections. Imperfections in the hybrids may allow leakage of signals back to a speaker's telephone from where the signals originated, giving rise

10 to the perception of an echo.

In conventional networks, the problem of echo is reduced by including an echo cancellation device in a telephone circuit if the propagation delay over the circuit

15 exceeds some predefined period (e.g. 15msec). As the route taken by a telephone circuit is not always predefined, the first exchange in the circuit identifies the "statically" defined delay for next leg and forwards this to the exchange at the end of that leg. The

20 receiving exchange then appends the delay for the next leg to the already accumulated delay and forwards this to the next exchange and so on. When the accumulated delay exceeds the predefined period, a backward message is sent to the originating exchange asking for an

25 incoming or outgoing echo cancellation device to be included in the circuit.

The above process works because in conventional telephone circuits, which use circuit switched traffic

30 channels, the propagation delay over a circuit leg can be predicted with great accuracy. The proposal to transmit telephone voice data between exchanges using a packet switched network upsets this situation as by its very nature packet switched circuits are unpredictable.

35 Unpredictability arises both because a packet may be transmitted between two end points by one of several

different routes and because the network uses only a
"best effort" to transmit a packet, i.e. if the network
is busy a packet may have to wait or may indeed be lost.
The propagation delay over a circuit link provided by a
5   packet switched network cannot therefore be statically
defined.

Summary of the Present Invention

10   It is an object of the present invention to overcome or
at least mitigate the above noted disadvantages of using
packet switched networks in telecommunication networks.
It is a further object of the present invention to
provide a telecommunication network in which the
15   propagation delay for voice data sent over a packet
switched network can be dynamically determined for the
purposes of echo cancellation.

According to a first aspect of the present invention
20   there is provided a method of determining the
propagation delay over a packet switched network
intended to provide a segment of a telephone circuit for
carrying information between at least two subscriber
terminals, the method comprising:
25   reacting to a request for a telephone circuit
between said two subscribers by transmitting a packet
containing an echo request message over the packet
switched network from a first network node to a second
network node;
30   reacting to receipt of the echo request message at
the second network node by transmitting a packet
containing an echo reply message over the packet
switched network from the second network node to the
first network node; and
35   and determining the round trip propagation delay
for the packet switched network segment on the basis of

the time which elapses between sending the echo request
message from the first node and receiving the echo reply
message also at the first node.

5   Preferably, the propagation delay for the packet
switched network segment is determined prior to the
sending of an Initial Address Message (IAM) over the
packet switched network segment. More preferably, the
determined round trip delay is appended or added to
10   delays determined for preceding circuit segments defined
in the IAM, for transmission over the packet switched
network.

Preferably, the method described above is employed with
15   an IP network.

According to a second aspect of the present invention
there is provided apparatus for determining the
propagation delay over a packet switched network
20   intended to provide a segment of a telephone circuit for
carrying information between at least two subscriber
terminals, the apparatus comprising:
       a first packet switched network node coupled
between a first subscriber and the packet switched
25   network and arranged to react to a request for a
telephone circuit between said two subscribers by
transmitting a packet containing an echo request message
over the packet switched network to a second packet
switched network node;
30   the second node being arranged to react to receipt
of the echo request message by transmitting a packet
containing an echo reply message over the packet
switched network to the first network node; and
       processing means associated with the first network
35   node arranged to determine the round trip propagation
delay for the packet switched network segment on the
basis of the time which elapses between sending the echo

request message from the first node and receiving the
echo reply message also at the first node.

5   Brief Description of the Drawings

For a better understanding of the present invention and
in order to show how the same may be carried into effect
reference will now be made, by way of example, to the
10   accompanying drawings, in which:
        Figure 1 shows schematically a telecommunications
system incorporating an IP network; and
        Figure 2 is a flow diagram showing a part of a call
set-up phase in the system of Figure 1.
15

Detailed Description of Certain Embodiments

There is illustrated in Figure 1 a telephone system in
which a pair of subscriber telephone terminals 1,2 are
20   connected to respective local access exchanges 3,4 via
PSTN access networks. The access exchanges 3,4 are in
turn connected to respective IP gateway nodes 5,6 via an
ISUP (ISDN User Part) interface. Interconnection
between the gateway nodes 5,6 is provided via an IP
25   network 7 which may be the Internet or, as is more
likely, a closed network employing the TCP/IP protocol.

It will be appreciated that the example shown in Figure
1 is greatly simplified and the system may include one
30   or more transit exchanges connecting the local access
exchanges 3,4 to the IP gateway nodes 5,6. Moreover,
the connection between the subscriber terminals 1,2 and
the access exchanges 3,4 may be made via one or more
intermediate "routers". It will also be appreciated
35   that the IP network 7 comprises a number of
interconnected routers such that the path taken by a

packet between the two gateway nodes 5,6 may vary under different circumstances.

Full details of a typical call set-up procedure in a
5   PSTN will not be given here. Rather, the reader is referred to for example to "Understanding Telecommunications", Studentlitteratur, Sweden (ISBN 91-44-00214-9). For the purpose of the present discussion it is sufficient to note that after an access exchange 3
10 receives a B-number dialled by a subscriber telephone 1, interexchange signalling takes place over the ISUP interface to establish a telephone circuit for the requested call.

15 In the example of Figure 1, an Initial Address Message (IAM) requesting allocation and reservation of a circuit is passed from the access exchange 3 to the gateway node 5. This IAM identifies the destination exchange 4, from which the gateway node 5 determines that the next leg of
20 the circuit extends over the IP network 7 to the second gateway node 6. The originating side gateway node 5 formulates an Echo Request message and transmits this over the IP network 7 to the terminating side gateway node 6, which responds by returning an Echo Reply
25 message. On the basis of the time elapsed between transmitting the Echo Request message and receiving the Echo Reply message the originating side gateway node 5 is able to determine the round trip propagation delay for a data packet under the current IP network
30 conditions.

The determined propagation delay is then appended to any accumulated delays already included in the IAM received by the originating side gateway 5 from the access
35 exchange 3 (e.g. the round trip propagation delay between the access exchange 3 and the gateway node 5).

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The modified IAM is then sent over the IP network 7 to the terminating side gateway node 6 where the (static) round trip propagation delay for the link between that gateway node 6 and the terminating side exchange 4 is
5 . further appended to the IAM contained delay. The IAM can then be passed to the terminating exchange 4. Following the establishment of the complete telephone circuit, an Address Complete Message (ACM) is returned from the terminating exchange 4 to the originating
10 exchange 3, the message containing the total accumulated propagation delay.

A decision on whether to introduce an incoming or outgoing echo cancellation device into the telephone
15 circuit may be made at the originating exchange 3 on the basis of accumulated propagation delay returned in the ACM. Alternatively, an echo cancellation device may be introduced at the terminating side access exchange 4.

20 Figure 2 illustrates further the steps involved in calculating the round trip propagation delay at the originating side gateway node 5.

It will be appreciated by the person of skill in the art
25 that modifications may be made to the above described embodiment without departing from the scope of the present invention. For example, whilst the above description has been concerned with the use of an IP network, the invention is applicable to any suitable
30 packet switched network.

Claims

1.   A method of determining the propagation delay over
a packet switched network intended to provide a segment
of a telephone circuit for carrying information between
at least two subscriber terminals, the method
comprising:
        reacting to a request for a telephone circuit
between said two subscribers by transmitting a packet
containing an echo request message over the packet
switched network from a first network node to a second
network node;
        reacting to receipt of the echo request message at
the second network node by transmitting a packet
containing an echo reply message over the packet
switched network from the second network node to the
first network node; and
        and determining the round trip propagation delay
for the packet switched network segment on the basis of
the time which elapses between sending the echo request
message from the first node and receiving the echo reply
message also at the first node.

2.   A method according to claim 1 and comprising
determining the propagation delay for the packet
switched network segment prior to the sending of an
Initial Address Message (IAM) over the packet switched
network segment.

3.   A method according to claim 2 and comprising
appending or adding the determined round trip delay to
delays determined for preceding circuit segments and
defined in the IAM, for transmission over the packet
switched network.

4.   A method according to any one of the preceding
claims wherein the packet switched network is an IP
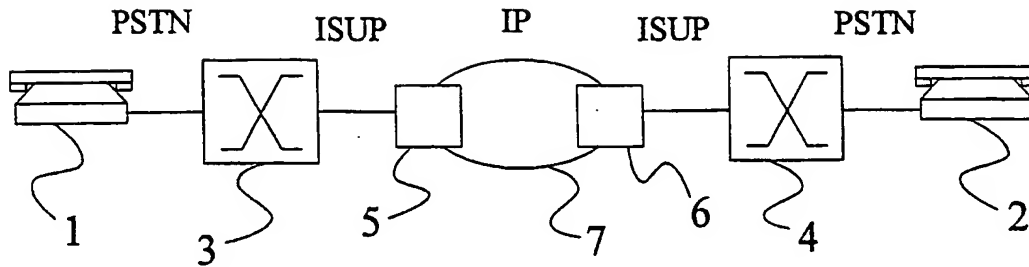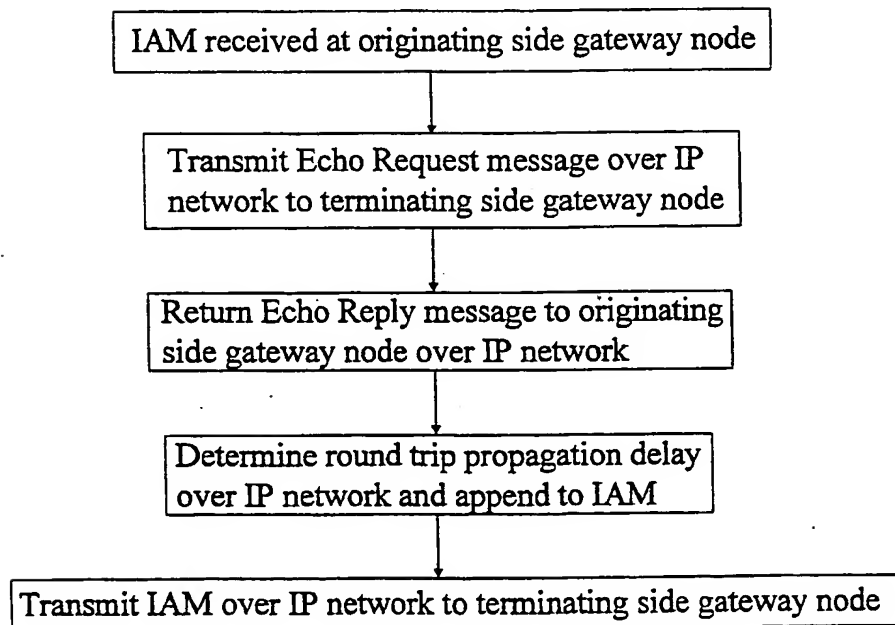network.

5   5.   Apparatus for determining the propagation delay
over a packet switched network intended to provide a
segment of a telephone circuit for carrying information
between at least two subscriber terminals, the apparatus
comprising:

10   a first packet switched network node coupled
between a first subscriber and the packet switched
network and arranged to react to a request for a
telephone circuit between said two subscribers by
transmitting a packet containing an echo request message

15   over the packet switched network to a second packet
switched network node;
        the second node being arranged to react to receipt
of the echo request message by transmitting a packet
containing an echo reply message over the packet

20   switched network to the first network node; and
        processing means associated with the first network
node arranged to determine the round trip propagation
delay for the packet switched network segment on the
basis of the time which elapses between sending the echo

25   request message from the first node and receiving the
echo reply message also at the first node.

PSTN   ISUP   IP   ISUP   PSTN

1   3   5   7   6   4   2

Figure 1

IAM received at originating side gateway node

Transmit Echo Request message over IP network to terminating side gateway node

Return Echo Reply message to originating side gateway node over IP network

Determine round trip propagation delay over IP network and append to IAM

Transmit IAM over IP network to terminating side gateway node

Figure 2

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7   H04L12/64

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7   H04L

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Y	page EP090595, column 3, line 57 —column 4, line 12	2-4
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P,X	EP 0 905 959 A (COMVERSE NETWORK SYST INC) 31 March 1999 (1999-03-31) column 5, line 5 - line 19 column 13, line 42 - line 55	1,4,5

☐ Further documents are listed in the continuation of box C.   ☒ Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
7 February 2000	18/02/2000

| Name and mailing address of the ISA European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31–70) 340–2040, Tx. 31 651 epo nl, Fax: (+31–70) 340–3016 | Authorized officer Gregori, S |

Form PCT/ISA/210 (second sheet) (July 1992)

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

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